



Recovery Act Program Plan

For

Aeronautics Research

Within the

American Recovery and Reinvestment Act of 2009

Program: NASA Aeronautics Research
TAFS: 80-0126
Date Submitted: May 15, 2009

Program-Specific Recovery Plan for Recovery.gov	
Does this program align with an existing PART program?	Yes, Aeronautics Research
Does this program align with an existing CFDA program?	Yes-Small Business Innovation Research
1. Objectives	
Program Purpose	NASA's aeronautics research generates innovative concepts, technologies, and capabilities needed to enable revolutionary change to both the airspace and the aircraft that fly within it. This research will lead to a safer, more environmentally friendly, and more efficient national air transportation system. Recovery funds will accelerate research in advanced aircraft technologies and systems, aircraft safety, fuel efficiency, and the Next Generation Air Transportation System.
Public Benefits	<p>Recovery Act funds for NASA's Aeronautics Research Program and will accelerate key research, which will enhance the state of aeronautics for the nation, and provide a foundation for addressing the need for a Next Generation Air Transportation System (NextGen). These funds will also lead to job creation.</p> <p>Specifically, NASA conducts cutting-edge, fundamental research in traditional aeronautical disciplines and emerging fields to help transform our nation's air transportation system, and to support future air and space vehicles. NASA also maintains a critical set of aeronautics infrastructure, such as wind tunnels, that meet National and public needs. NASA's Aeronautics Research Program addresses research challenges that must be overcome in order to create the Next Generation Air Transportation System (NextGen). This research will help find solutions for increasing the capacity, efficiency, and flexibility of our national air space. At the same time, this research will help address substantial aircraft noise, emissions, efficiency, performance, and safety challenges that must be met in order to design new aeronautical vehicles that can support NextGen.</p> <p>Notably, given the already-high levels of air transportation safety, NASA's aeronautics research examines the additional solutions and technology to further reduce risk in this complex, dynamic operating domain of the Nations' aviation system. In addition to providing fundamental research on known safety concerns, the Aeronautics Research Program is also working with its partners to address the safety challenges created as the nation transitions to the Next Generation Air Transportation System (NextGen), including significant increases in air traffic, continued operation of legacy vehicles, introduction of new vehicle concepts, increased reliance on automation, and increased operating complexity.</p> <p>NASA also actively addresses environmental concerns, which directly can</p>

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	<p>benefit the public. As the number of flight operations at many of the largest airports in the nation continue to increase, environmental concerns over noise and emissions will limit the capacity of those airports, and therefore, of the entire aviation system. As NextGen evolves to handle the projected growth in the national air transportation system, NASA Aeronautics is working to answer major questions that the system will face such as: How will we continue to reduce the environmental impact of aviation (in terms of noise, local and global emissions, and local air quality) despite its very significant growth?, and, What kinds of advanced vehicles will be required to satisfy the forecasted demand and levels of environmental compliance? NASA is ensuring that new generations of vehicles can operate within the NextGen in a manner that is conducive to minimizing the environmental impact of aviation.</p> <p>For more information on these lines of research and the others that NASA Aeronautics conducts see http://www.aeronautics.nasa.gov.</p>
2. Projects and Activities:	
Kinds and scope of projects and activities to be performed	<p>NASA intends to invest \$150M of Recovery Act funds, into the existing Aeronautics Research Program, to enhance and expand the fidelity of current foundational research activities; ensure the availability of aeronautical test facilities; and conduct integrated system level research activities supporting NextGen. NASA's Aeronautics Research Program is comprised of four programs: Airspace Systems, Fundamental Aeronautics, Aviation Safety and Aeronautics Test. Research in all programs will be accelerated and enhanced through Recovery funds, some of which will be allocated to Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) activities.</p> <p>The Aviation Safety program will use these funds to enhance and expand the fidelity of current research activities relating to composite materials and structures experimentation, simulations and flight tests. NASA's flight test capabilities maintained and vehicle health monitoring work enhanced. A potential new research effort may expand available methods for the Validation and Verification of Flight Critical Systems in response to a Joint Planning and Development Office (JPDO)-identified aviation system capability gap. The JPDO, working with the FAA, NASA, the Departments of Transportation, Defense, Homeland Security, Commerce, and the White House Office of Science & Technology Policy, was established to facilitate NextGen activities. Its task is to create and carry out an integrated plan for NextGen, spearhead planning, and coordinate research, demonstrations and development in conjunction with relevant programs of other departments and agencies, and with the private sector.</p> <p>The Airspace Systems program will use Recovery funds to accelerate progress and conduct integrated system research to support the requirements and research and development gaps identified by the JPDO for NextGen advancements. Technology concepts could be developed that include</p>

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	<p>assessments of operational solutions and identification of technologies and procedures that will improve operational efficiency of the aviation system. Human-in-the-loop simulations and field demonstration/testing/trials may be conducted to initiate development of human/automation information requirements and decision making guidelines for human-human and human-machine decision making, as these two important components are combined to more efficiently operate aircraft and the airspace system.</p> <p>The Fundamental Aeronautics program will invest funds to reduce risk, accelerate progress, and initiate integrated aeronautical vehicle system level research in areas that have applicability to future vehicle concepts, reducing the impact of aviation on the environment. Vehicle concepts can be developed and matured to assess the viability of technologies like blended-wing-body shaping, low emission engine combustors, low noise/vibration rotorcraft-wings, and advanced structures. All of these technologies have the potential to contribute to aircraft efficiency, reduce the use of fuel or make an air-vehicle quieter. Integrated aircraft systems-level research determines the compatibility and environmental benefits of these technologies. Funding increases could also be used for development and wind tunnel testing of advanced vehicle shaping approaches needed for low-sonic boom supersonic aircraft, to enable community acceptance of supersonic flight over land.</p> <p>The Aeronautics Test program will invest funds to help protect current and provide additional test capabilities for the aeronautics programs, and will bolster NASA's expertise and capabilities in critical test areas. Construction associated with building new or modification of these test facilities is expected to have a direct benefit on local economies. Funds used for maintenance and facility and equipment upgrades, will improve mission support capability and enhance productivity.</p>
3. Characteristics:	
Types of Financial Awards to be used.	All work will be accomplished with contracts, cooperative agreements, and potentially grants.
Type of Recipient	The recipients of this work will be academic institutions, both non-profit and for-profit organizations, and small businesses.
Type of Beneficiary	The primary beneficiaries are the general public and its "scientist/researcher" and "engineer" communities.
4. Major Planned Program Milestones	
Schedule with milestones for major phases of the program's delivery	Many of the Aeronautics Research Program activities are associated with on-going research efforts with no defined end date, rather a continual quest for better scientific knowledge, technology development or of long-term educational value. However, specific research milestones are identified for on-going efforts. The planned activities associated with Recovery Act funding typically will be started between May and June 2009, with the first

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	<p>milestone evaluation at the end of calendar year 2009. The expected completion date of activities associated with Recovery Act funding is typically no later than September 2010.</p> <p>Note the following milestones are subject to change, based on the complex and highly dynamic nature of research and development-type activities.</p>
Milestone #1	<p>Complete aerodynamic wind tunnel evaluation of the re-design of a scaled free-flight Hybrid Wing Body (HWB) aircraft to optimize fuel-burn. This type of airplane configuration looks significantly different and is much advanced from today's vehicles. It offers the potential of lower emissions, noise generation, and fuel burn than aircraft currently available in the Nation's aircraft fleet. Wind tunnel evaluation of the modified design of this concept aircraft is a necessary step prior to free-flight evaluation of the design's handling characteristics.</p>
Expected Completion Date for Milestone #1	March 2010
Milestone #2	<p>Develop and demonstrate an automated test generation package for flight-critical software verification or validation focused on margin to failure modes relative to current operational scenarios. This research is developing tools used for validating and verifying flight-critical software used in aviation systems. There are challenges for verification and validation for the next generation of flight-critical systems. Advances in technology are placing an increasing strain on the ability to assure the integrity of new and anticipated flight software systems. Additionally, there is a perception that current approaches for the assurance of complex flight-critical systems impose a barrier to innovation. Thus, the NASA Aeronautics Research Program is working on innovative approaches, technologies and processes to address these concerns. The specific focus is on flight-critical systems (i.e., systems comprising hardware, software and physical systems, used to execute pre-defined concepts of operation or operating procedures, and interacting with human operators including pilots and controllers) that will directly control some aspect of flight and thus must be demonstrated to the highest levels of safety. The objective is to develop techniques, tools, and methods to enable efficient and accurate analysis of safety aspects of software-intensive systems; ultimately reducing the cost of software verification and validation; and enabling in-the-field assurance of composed software-intensive systems.</p>
Expected Completion Date for Milestone #2	September 2010

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Milestone #3	Complete design for the Icing Capability in the Glenn Research Center Propulsion System Laboratory. The Propulsion Systems Laboratory is a ground-based test facility that can provide true flight simulation for experimental research on air-breathing propulsion systems, i.e., aircraft engines. Currently the facility cannot simulate conditions where icing forms in an engine. Ice formation in an airplane engine can lead to operability issues, temporary thrust loss, and can damage part of the engine. The modifications to this facility will allow NASA and its research partners to better conduct important research in this area, and develop techniques to mitigate engine icing.
Expected Completion Date for Milestone #3	December 2009
5. Monitoring and Evaluation:	
Monitoring/Evaluation: Description of Agency periodic review and review of partners progress	<p>NASA uses multiple methods, processes and entities for monitoring and evaluating performance. These same procedures will be used for activities funded under the Recovery Act. NASA programs are assessed for relevance, quality, and performance. A relevance review assures alignment with national priorities, the NASA Strategic Plan, impact on related fields of research or technology, and “customer” needs. Determining quality is prospective and assures “best value” for an investment, using peer review processes. Performance reviews evaluate whether a program is on track to meet its baseline performance commitments (cost, schedule, science/technical deliverable).</p> <p>Reviews are conducted internal and external to NASA. External evaluations are performed by entities such as the NASA Advisory Council (NAC) and the National Research Council to assess NASA’s program content and direction. Additional independent reviews are commissioned by the NASA Administrator or mission organizations to review programs for relevance, quality and performance. Reviews are rigorous, methodical and focused on program methods, results and findings.</p> <p>Responsibility for program and project management and their control mechanisms (NASA Procedural Requirements (NPR) 7120 series)*, institutional management (NPR 8500 series)*, and financial management (NPR 9010 and 9120 series)*, occurs at all management levels of the Agency. NASA’s management monitors different aspects of program or institutional performance, at the highest Agency levels, and uses a rigorous structure of program and management reviews for Agency-level decisions. To continue through each phase of development, programs must demonstrate, on an on-going basis, an ability to manage in a manner that produces identifiable results, and must document performance against previously defined commitments including multi-year outputs, annual performance goals, milestones and other metrics, as appropriate.</p> <p>NASA internally monitors performance through monthly and quarterly reviews at each management level. At the senior management level, program reviews, accompanied by an independent (internal) assessment, occur across</p>

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	<p>all mission areas, with an in-depth review each quarter rotating among the mission organizations. Senior management also reviews institutional data (finance, human capital, acquisition, infrastructure), and aggregated Agency measures and metrics, e.g., safety, cross-cutting technical and non-technical issues. The data reviewed, and the accompanying analysis, allows the Agency to focus on, and proactively address, issues that could lead to not achieving desired performance goals.</p> <p>Specific to the Aeronautics Research Program is also the conduct of six-month and annual reviews of the performance of the programs, with subject matter experts participating in the annual reviews. All findings and recommendations are documented. The Aeronautics Committee of the NAC provides annual input reflecting community opinions and recommendations. This information is used to assess progress toward meeting long-range outcomes, develop risk mitigation strategies, adjust priorities, make additional resource allocation, or take other management actions.</p> <p>Regarding program partners, the Aeronautics Research Program maintains an extensive, competitive process using NASA Research Announcements (NRAs) to solicit proposals from educational institutions, non-profit organizations and industry engaged in foundational research. Details on the NRA process can be found at http://www.aeronautics.nasa.gov. When NASA Aeronautics works with government partners, the respective agencies are accountable for cost, schedule and performance results; reviews occur routinely between and among all parties to ensure commitments are delivered on schedule and within budget.</p> <p>* The NASA Online Directives Information System Library ensures access by NASA employees and contractors to the most current documentation.</p>
6. Measures:	
Measure Text	Achieve progress on key development activities that support Fundamental Aeronautics research objectives to enable the design of vehicles that fly through any atmosphere at any speed.
Measure Type	Output
Measure Frequency	Quarterly
Direction of Measure	+
Unit of Measure	Percent
Explanation of Measure	<p>NASA completes many research and technology development activities that demonstrate progress toward reaching the program research objectives. The long-term outcomes and additional information on research activities supporting Fundamental Aeronautics can be found at:</p> <p>http://www.aeronautics.nasa.gov/fap/index.html</p>

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	<p>Each quarter a series of activities are tracked for their successful completion. Recovery fund activities will enhance and strengthen the current research supporting Fundamental Aeronautics.</p> <p>NASA will complete 90% of the planned activities supported with Recovery Act funds, which include:</p> <ul style="list-style-type: none"> • Develop a laminar flow Hybrid Wing Body (HWB) model for assessment at high Reynolds number in the National Transonic Facility (NTF) • Design, develop, and test an inlet-fan system designed for aircraft boundary layer ingestion • Design, develop and test aircraft-engine ultra-high bypass component technology hardware • Design and fabricate combustor rig improvements to enable testing of advanced low nitrogen oxide injector designs • Conduct X-48B/C trailing edge modification wind tunnel and flight experiments • Fabricate and install a tilt-rotor drive system in the National Full-scale Aeronautics Complex to enable advanced tilt-rotor research, and design and fabricate instrumented blades for use in tilt-rotor aeroelastics research. • Conduct wind tunnel assessment of aircraft designs optimized for low sonic-boom generation.
Year	2009, 2010
Original Program Target	N/A
Revised Full Program Target	90
Target (incremental change in performance)	90
Actual	
Goal Lead	Associate Administrator for Aeronautics
Measure Text	Variance from the planned cumulative obligations for the Aeronautics Research Program.
Measure Type	Output
Measure Frequency	Quarterly
Direction of Measure	+
Unit of Measure	Percent
Explanation of Measure	<p>A key aspect of the American Recovery and Reinvestment Act, is to assure the timely obligation of funds to the intended beneficiaries.</p> <p>NASA plans to make every effort to assure this happens on the plan that it has put forward, which has been designed to also maintain a</p>

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	<p>prudent use of taxpayer funds, and provide key research and development program deliverables to the benefit of the public. An obligation of funds means a binding agreement is made with NASA's contractors and grantees that will result in outlays (or a payment for the services or goods they provided), immediately or in the future. NASA will measure its progress toward the planned obligations to-date, on a quarterly basis.</p> <p>NASA's baseline obligation plan (when available) is posted at www.nasa.gov/Recovery/.</p>
Year	2009, 2010
Original Program Target	10
Revised Full Program Target	10
Target (incremental change in performance)	0
Actual	
Goal Lead (Name)	Associate Administrator for Aeronautics
Measure Text	Variance from the planned cumulative outlays for the Aeronautics Research Program.
Measure Type	Output
Measure Frequency	Quarterly
Direction of Measure	+
Unit of Measure	Percent
Explanation of Measure	<p>A key aspect of the American Recovery and Reinvestment Act, is to assure the timely outlay of funds to the intended beneficiaries.</p> <p>NASA plans to make every effort to assure this happens on the plan that it has put forward, which has been designed to also maintain a prudent use of taxpayer funds, and provide key research and development program deliverables to the benefit of the public. An outlay of funds means a payment that fulfills an obligation and is the measure of Government spending. This is a payment for the services or goods the contractor or grantee provided. NASA will measure its progress toward the planned outlays to-date, on a quarterly basis.</p> <p>NASA's baseline outlay plan (when available) is posted at www.nasa.gov/Recovery/.</p>
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Original Program Target	10
Revised Full Program Target	10
Target (incremental change in performance)	0
Actual	
Goal Lead	Associate Administrator for Aeronautics
Measure Text	Achieve progress on key development activities that support Aviation Safety research objectives to develop innovative tools, concepts, methods, and technologies that will improve the intrinsic safety attributes of current and future aircraft and of aviation operations.
Measure Type	Output
Measure Frequency	Quarterly
Direction of Measure	+
Unit of Measure	Percent
Explanation of Measure	<p>NASA completes many research and technology development activities that demonstrate progress toward reaching the program research objectives. The long-term outcomes and additional information on research activities supporting Aviation Safety can be found at: http://www.aeronautics.nasa.gov/programs_avsafe.htm</p> <p>Each quarter, a series of activities are tracked for their successful completion. Recovery fund activities will enhance and strengthen the current research supporting Aviation Safety.</p> <p>NASA will complete 90% of the planned activities supported with Recovery Act funds, which include:</p> <ul style="list-style-type: none"> • Strengthen experimental research and systems integration in composite materials and structures. • Provide enhanced materials and structures models, and higher fidelity simulations resulting in the ability to qualify performance prediction uncertainty in realistic environments. • Extend flight research of adaptive control technologies to prevent loss-of-control • Define, integrate and conduct initial research efforts in verification & validation of flight critical systems to respond to Joint Planning and Development Office (JPDO)-identified gap in key national capabilities
Year	2009, 2010
Original Program Target	N/A

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Revised Full Program Target	90
Target (incremental change in performance)	90
Actual	
Goal Lead	Associate Administrator for Aeronautics
Measure Text	Achieve progress on key development activities that support Airspace Systems research objectives to enable new capabilities for the airspace and airports (airport gates, taxiways, runways, and airport approach airspace) of a Next Generation Air Transportation System (NextGen).
Measure Type	Output
Measure Frequency	Quarterly
Direction of Measure	+
Unit of Measure	Percent
Explanation of Measure	<p>NASA completes many research and technology development activities that demonstrate progress toward reaching the program research objectives. The long-term outcomes and additional information on research activities supporting Airspace Systems can be found at: http://www.aeronautics.nasa.gov/programs.asp.htm</p> <p>Each quarter a series of activities are tracked for their successful completion. Recovery fund activities will enhance and strengthen the current research supporting Airspace Systems.</p> <p>NASA will complete 90% of the planned activities supported with Recovery Act funds, which include:</p> <ul style="list-style-type: none"> • Address critical gaps in NextGen R&D with specific emphasis on Joint Planning and Development Office (JPDO) identified High Value Focus Areas • Conduct deeper assessments of safety issues and risks for NextGen concepts • Develop concept of operations requirements and analysis for government Unmanned Aviation Systems (UAS) access to the NAS in near term and for civil UAS access in the long term, in cooperation with other agencies • Build enhanced systems analysis and simulation capabilities to support exploration of NextGen operations concepts
Year	2009, 2010
Original Program Target	N/A
Revised Full Program Target	90

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Target (incremental change in performance)	90
Actual	
Goal Lead	Associate Administrator for Aeronautics
Measure Text	Aeronautics ground test facilities are available and operational in order to support the research, development, test, and engineering milestones of NASA and DoD programs from both schedule and cost perspectives. This metric is known as "on-time availability."
Measure Type	Efficiency
Measure Frequency	Annual
Direction of Measure	Measures should be increasing (strengthen and accelerate)
Unit of Measure	Percentage
Explanation of Measure	<p>NASA completes many research and technology development activities that demonstrate progress toward reaching the program research objectives. The long-term outcomes and additional information on research activities supporting the Aeronautics Test Program can be found at: http://www.aeronautics.nasa.gov/atp/index.html</p> <p>Each quarter a series of activities are tracked for their successful completion. Recovery fund activities will enhance and strengthen the capabilities and availability of ground test facilities that support multiple aeronautics programs.</p> <p>NASA will complete 90% of the planned activities supported with Recovery Act funds, which include:</p> <ul style="list-style-type: none"> • Modifications on the 14 x 22 Low Speed Wind Tunnel to enable HWB acoustic shielding characteristics testing • Add high altitude ice crystal capability in the Propulsion Systems Laboratory • Make performance and productivity enhancements to the NTF • Relocate Ames Research Center Unitary Plan Wind Tunnel make-up-air compressor • Repair the refrigeration system at the Icing Research Tunnel
Year	2009/2010
Original Program Target	94%
Revised Full Program Target	96%
Target (incremental change in performance)	+2%
Actual	

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Goal Lead	Associate Administrator for Aeronautics
7. Transparency and Accountability:	
Description of the program's collection of grantee performance data on an annual basis and make it available to the public in a transparent and meaningful manner	<p>NASA currently utilizes multiple methods to assure transparency and accountability, and will apply these standard processes and procedures to activities supported by Recovery Act funds. The principle of transparency is applied to program and fund allocation planning methods, and in reporting, both internal and external to the Agency, of progress toward the resultant plans. NASA requires accountability at all levels of management and from all of its cost-sharing and non-cost sharing partners, contractors, and grantees for the timely delivery and quality of products.</p> <p>Rigor is applied to NASA programs' design, structure, management, and funding to ensure that resources reach the intended beneficiaries and address the programs' purpose directly. Transparent, merit-based criteria and decision-making procedures are employed at multiple steps in this process. Governing documents, such as the NASA Strategic Plan and supporting mission specific plans, guide the activities of these programs and provide the context through which specific science and research objectives are formulated, investigations are solicited, and missions or activities that address them are planned. Missions are prioritized on the basis of expert opinion such as Decadal Surveys on science, available budget resources, technological maturity, and partnering opportunities.</p> <p>As explained in detail in the Monitoring and Evaluation Section of this Program Plan, NASA will employ multiple methods of review and evaluation of progress toward the goals of this Program Plan. These reviews will assure that funds are being utilized as intended and are delivering on their committed objectives. Managers at all levels will be held accountable both via review of their progress and individual performance plans. At NASA, all employee performance plans for Federal managers include elements tied to the program plans for which they are responsible.</p> <p>Contractors will be held accountable for the timely delivery and quality of products. Award fee reviews, where appropriate, will be performed on contracts and past performance evaluations are integral in solicitation criteria. Grants and cooperative agreements are subject whenever possible to deliverables and milestones that must be met in order to receive funding renewal. International and Federal government partners work in accordance with applicable Memoranda of Understanding (MoUs) and agreements, which generally detail schedule and performance commitments.</p> <p>Contractor and government accounting systems are audited periodically to ensure compliance with government standards. Specific reports that record and track the obligation and expenditure of program funds are as follows: contractor monthly and quarterly reports, reports on budget execution and budgetary resources, the year-end closing statement, and the annual Performance and Accountability Report. Additionally, NASA will cooperate</p>

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	<p>with the Government Accountability Office and the NASA Office of Inspector General through various engagements and audits that monitor specific items dealing with Recovery funds.</p> <p>To assure transparency and accountability to the public and its key stakeholders, NASA will post its current plans, and outline any revisions to previous versions on the Agency Recovery Act website. Information will be available on key events, the status of on-going activities, outcomes of Inspector General Audits and the accomplishment of and performance toward, annual and long-term Recovery Program goals. Web links will be provided, where applicable to posted solicitations, awards, and grantee performance, among other relevant information. For this and other important information on NASA implementation of the Recovery Act, see http://www.nasa.gov/recovery/.</p>
8. Federal Infrastructure Investments:	
Description of Agency plans to spend funds effectively to comply with energy efficiency and green building requirements	<p>NASA uses best practices of sustainable design, maintainable design, building commissioning, and safety and security are incorporated, to the maximum extent possible, into the planning and execution of facility projects. Within this program NASA will be making modifications to its aeronautical test facilities, and where applicable, will follow the appropriate Agency requirements outlined below.</p> <p>NASA Facility Project Managers ensure project designs take into account the energy demands, intended use, occupancy, operations, plug loads, and design to earn the ENERGY STAR targets for new construction and major renovation where applicable. ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy to help save money and protect the environment through energy efficient products and practices (http://www.energystar.gov/). NASA Facility Project Managers are also responsible for ensuring compliance with Executive Order (EO) 13423, Strengthening Federal Environmental, Energy, and Transportation Management.</p> <p>For new construction, NASA is striving to reduce the energy cost budget by 30 percent compared to the baseline building performance rating per the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., (http://www.ashrae.org/) and the Illuminating Engineering Society of North America (http://www.iesna.org/). For major renovations, NASA is aiming to reduce the energy cost budget by 20 percent from pre-renovations 2003 baseline.</p> <p>NASA has adopted the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) as its performance measure for sustainable development (http://www.usgbc.org). LEED provides a structure for identifying and implementing practical and measurable green building design, construction, and operations. It is NASA policy that all new</p>

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	construction and major building renovation projects meet the minimum LEED Silver rating.
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